The Climate Forecast System at NCEP

William. M. Lapenta

Acting Director

Environmental Modeling Center

NOAA/NWS/NCEP

With contributions from EMC Staff. . . . . .

NOAA/NWS Data Assimilation and Modeling

Everything you read, see or hear about weather, climate and ocean forecasts is based on numerical prediction

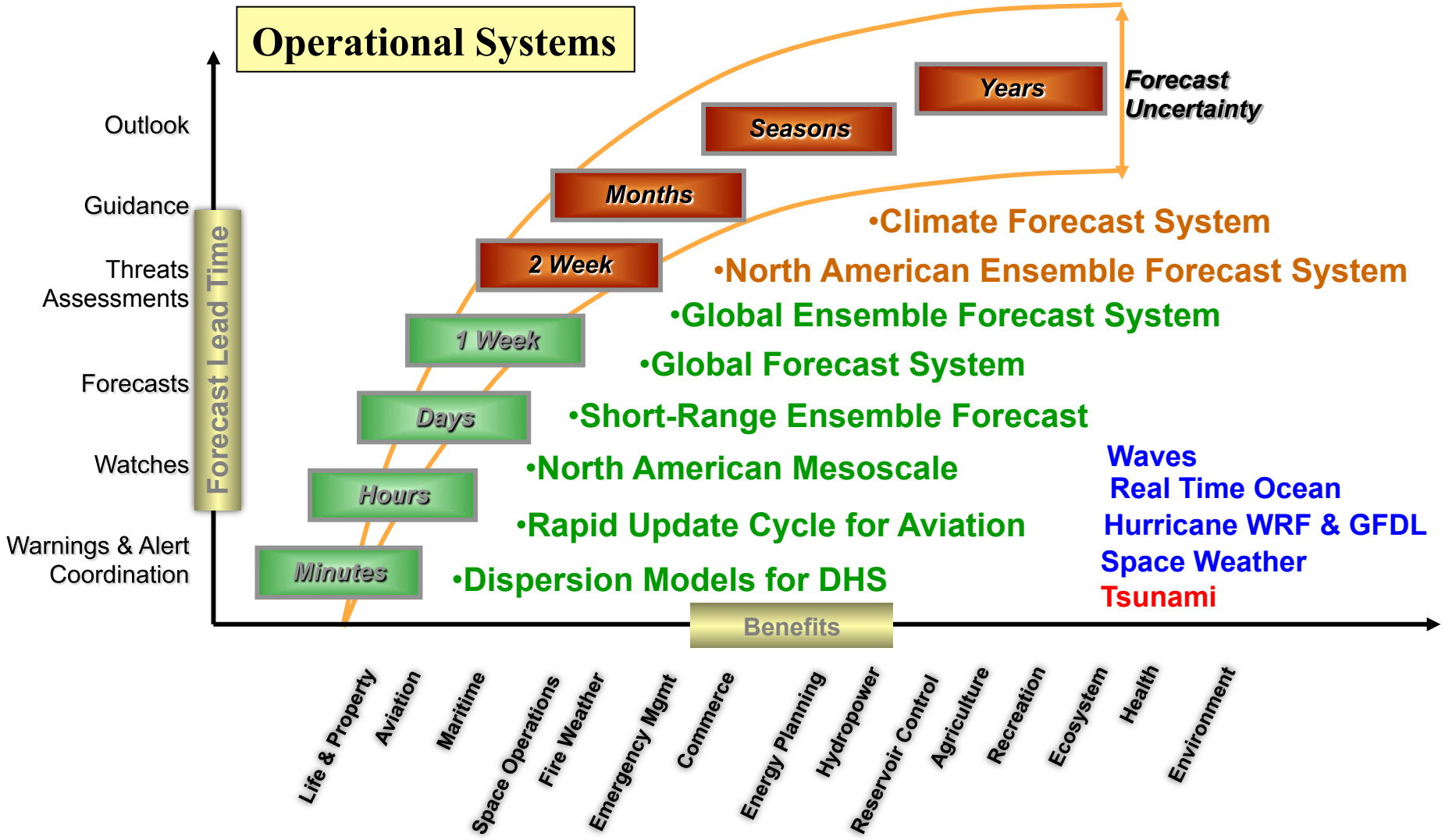
Three Major Components of the Numerical Prediction Enterprise….

1. Global Observing System
2. Computers (WCOSS, AWIPS2)
3. Data Assimilation & Modeling

NOAA Science Serving Society….

NCEP Science Support Contract
I.M. Systems Group
89 Employees: 83 B.S; 71 M.S.; 63 PhD

NOAA Seamless Suite of Numerical Guidance Products Spanning Weather and Climate



NCEP Production Suite Supports NOAA/ NWS Operational Requirements

Boxes marked with a "X" indicate where a Data Assimilation and Modeling numerical guidance system directly supports a NWS GRPA Goal

Existing GPRA

Planned GPRA

NWS Government Performance and Results Act Goals

NWS GPRA Goals	NCEP Production Suite Numerical Guidance Systems														
	HYSPLIT	RAP	NAM	SREF	GFS	GEFS	NAEFS	CFS	HYCOM	WW3	Wave Ensemble	Tsunami	HWRF	GFDL	ENLIL
Flash Flood Warnings Lead Time		X	X	X	X	X	X								
Flash Flood Warnings Accuracy		X	X	X	X	X	X								
Marine Wind Speed Forecast Accuracy			X	X	X	X	X		X						
Marine Wave Height Forecast Accuracy					X	X			X	X	X				
Aviation Forecast IFR Accuracy	X	X	X												
Aviation Forecast IFR False Alarm Ratio		X	X												
Winter Storm Warnings Lead Time		X	X	X	X	X	X								
Winter Storm Warnings Accuracy		X	X	X	X	X	X								
IMET Fire Response Time			X												
Precip Forecast Day 1 Threat Score			X	X	X	X	X								
US Seasonal Temp Forecast Skill								X							
Hurricane Forecasts Track - 48 hr Error					X	X							X	X	
Hurricane Forecasts Intensity - 48 hr Error													X	X	
Tsunami Message Response Time												X			
Geomagnetic Storm Forecast Accuracy															X
Geomagnetic Storm Forecast False Alarm Ratio															X

Requirements for the NOAA Climate Forecast System

Service and Societal:

- Directly supports the US Seasonal Temperature GPRA Goal
- Supports climate monitoring, predictions and projections globally and regionally
- Inform adaptation planning and decision making

Scientific Understanding:

- Advance understanding of climate variability and change and their impact on the Earth system
- Facilitate research on the interplay between climate and weather (including high-impact weather events)
- Develop process-level understanding of climate forcing mechanisms and interactions in a variable and changing climate system

Advancement of Climate Forecast System

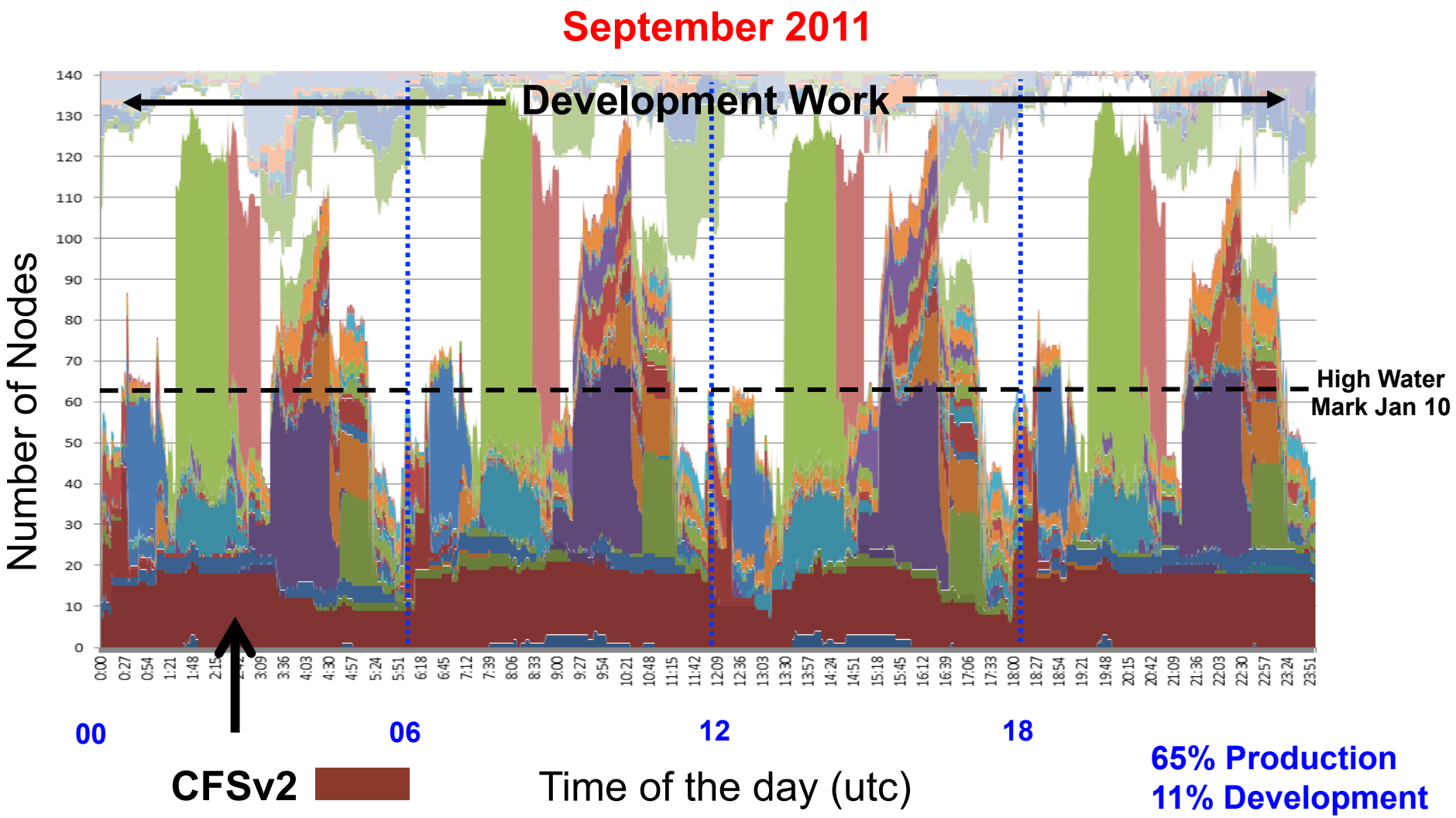
Implemented 30 March 2011

Attribute	CFSv1 (2004-2011)	CFSv2: March 2011
Analysis Resolution	200 km	27 km
Atmosphere model	200 km/28 levels Humidity based clouds	100 km/64 levels Variable CO2 AER SW & LW radiation Prognostic clouds & liquid water Retuned mountain blocking Convective gravity wave drag
Ocean model	MOM-3: 60N-65S 1/3 x 1 deg. Assim depth 750 m	MOM-4 fully global ¼ x ½ deg. Assim depth 4737 m
Land surface model (LSM) and assimilation	2-level LSM No separate land data assim	4 level Noah model GLDAS driven by obs precip
Sea ice	Climatology	Daily analysis and Prognostic sea ice
Coupling	Daily	30 minutes
Data assimilation	Retrieved soundings, 1995 analysis, uncoupled background	Radiances assimilated, 2008 GSI, coupled background
Reforecasts	15/month seasonal output	25/month (seasonal) 124/month (week 3-6)

Operational Configuration for the Climate Forecast System V2

- Provides a time-lagged ensemble
- A total of 16 CFS runs every day
  - 4 runs @ 9 months length
  - 3 runs @ 1 season
  - 9 runs @ 45 days

Production Suite on Supercomputer



Requirements for Reanalysis

- **Reanalysis is a comprehensive global, multi-decadal dataset generated by the latest numerical data assimilation techniques using various past observations**

- **Reanalysis data have consistent technical quality over decades and provide vital context to many types of meteorological and climatological research and applications:**

  - **Monitoring and understanding climate variability and trends**
  - **Develop statistics of extreme events on a regional basis**
  - **Provides a dataset for model validation**
  - **Allow model developers to study the prediction and predictability questions on intra-seasonal to inter-annual time scales**
  - **Dynamic and statistical downscaling studies**

- **Reanalyses have already had enormous benefits for had climate research and prediction research prediction, as well as for a , wide range of societal applications**

Requirements for Reforecasts

- A reforecast is a retrospective weather forecasts generated with a fixed numerical model
- Model developers use them for diagnosing model bias, thereby facilitating the development of new, improved versions of the model
- Others could use them as data for statistically correcting weather forecasts, thereby developing improved, user-specific products
- Basic research for improved understanding predictability
  - ENSO
  - MJO
  - Monsoon
  - Extreme events
  - Dynamic and statistical downscaling
  - Ensemble generation methods for ISI time scales

Looking Forward….

- **Identify and document customer expectations for next generation CFS**

- **NOAA must build plan to meet current and emerging customer requirements—science based approach**

- **Must include reanalysis and reforecast components**
  - **Model—land, atmosphere, ocean, ice**
  - **Analysis—observations, assimilation, models**
  - **Monitoring**

- **Community requests inclusion in the development process**
  - **Intellectual**
  - **Access to information (data)**
  - **Accountability**

Questions Welcome